6.0 DOMINGUEZ CHANNEL WATERSHED MANAGEMENT AREA

6.1 Watershed Description

6.1.1 Watershed Land Use, Percent Impervious, and Population

The Dominguez Channel Watershed Management Area is dominated by urban land uses such as residential, industrial, commercial, and transportation, which together comprise 85% of the land area (Figure 6-1). The water land use category includes the Los Angeles and Long Beach Harbors. The distribution of land use patterns appears to be a mixed patchwork of residential, commercial, and industrial (Figure 6-2). The eastern portion of the watershed near the Dominquez Channel has a high concentration of industrial land uses. Very little vacant and open spaces are present in the watershed.

The average impervious area of the Dominguez Watershed is estimated to be 59% based on assumptions of impervious areas in each land use type. This is the highest ratio of impervious land in the six Watershed Management Areas.

The highest population density in the Dominguez Channel WMA appears to be above the mass emission station in the communities of Inglewood and Hawthorne (Figure 6-3).

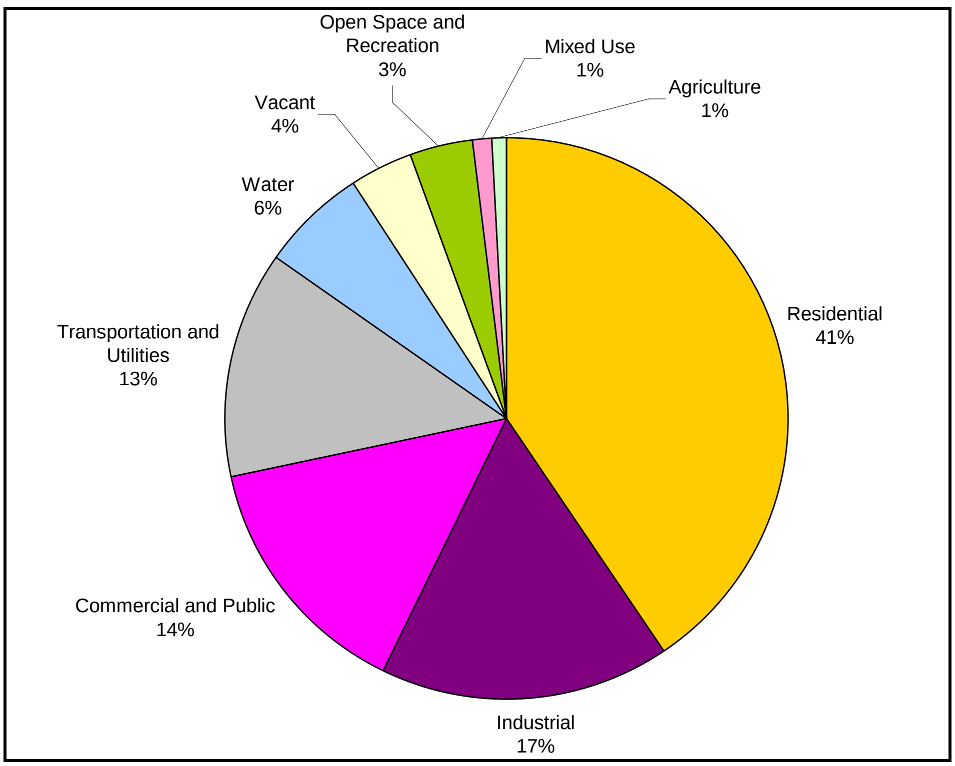

Figure 6-1. Land Use Percentages in the Dominguez Channel WMA.

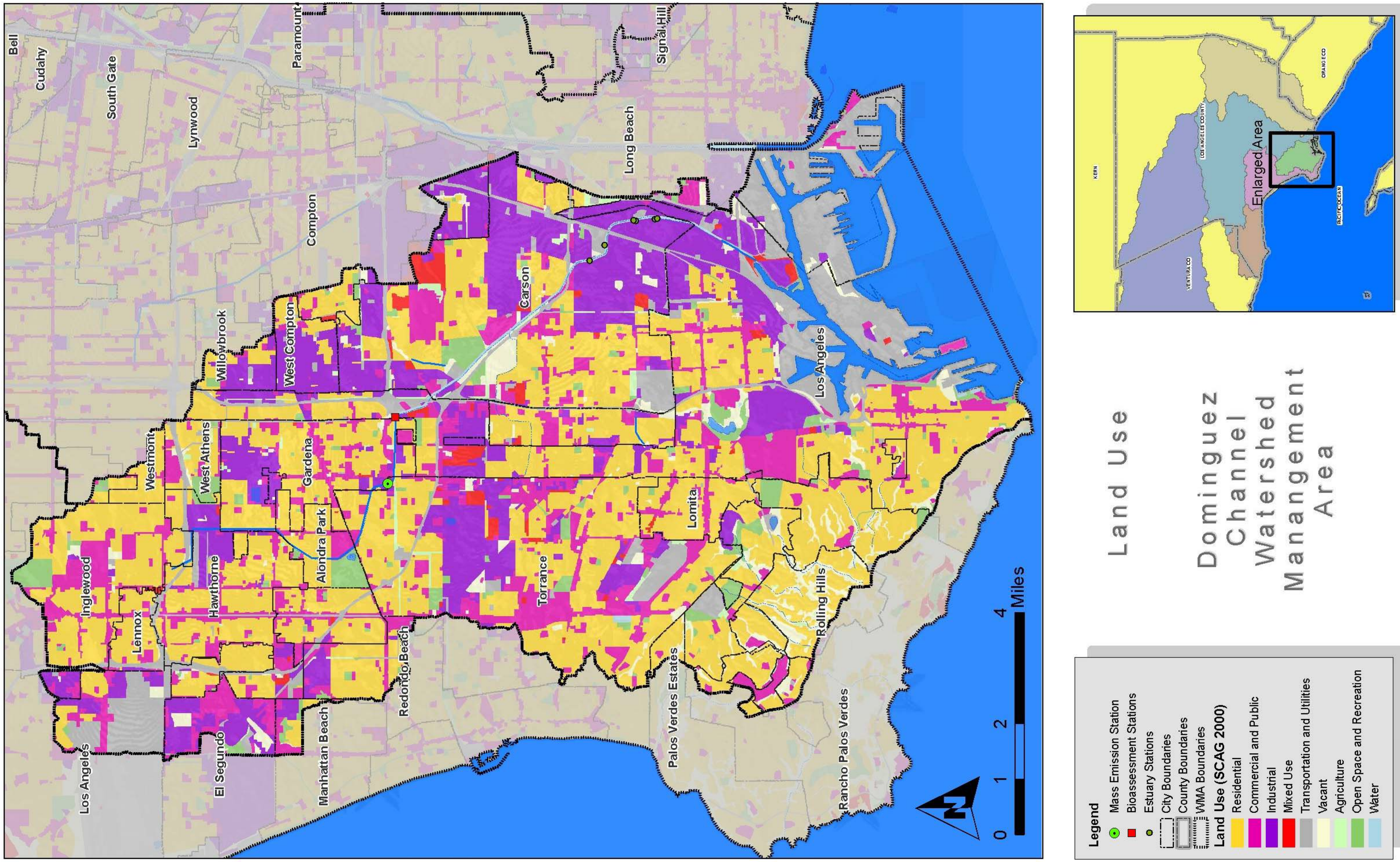

Figure 6-2. Land Use Distribution in the Dominguez Channel Watershed.

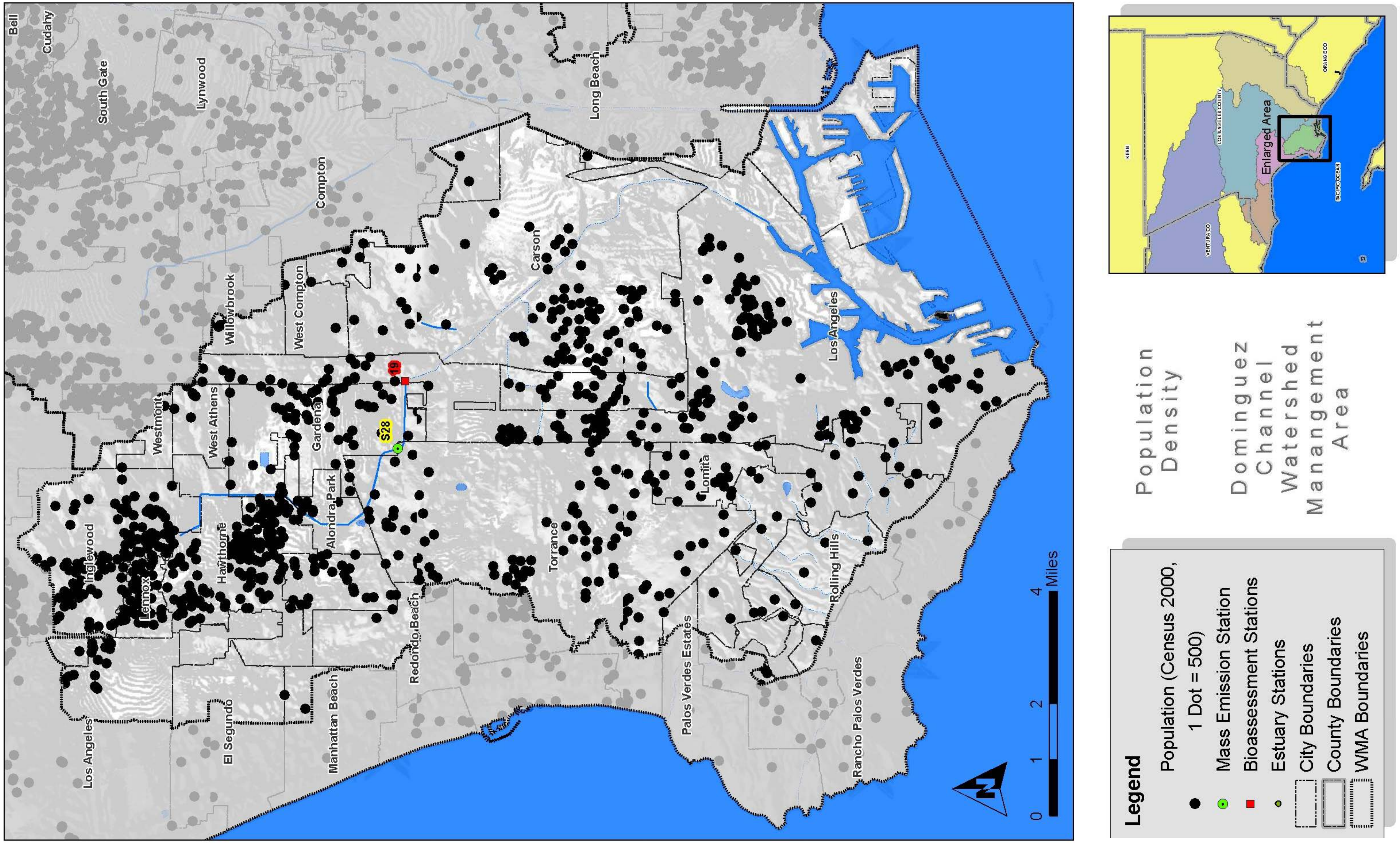

Figure 6-3. Population Density in the Dominguez Channel WMA.

6.1.2 Hydrology and Monitoring Stations

The Dominguez Channel Watershed drains an area of approximately 133 square miles in southwestern Los Angeles. The watershed is composed of two hydrologic subunits. The two subunits drain primarily via an extensive network of underground storm drains. The northern subunit drains into the Dominguez Channel while the southern subunit drains directly into the Los Angeles and Long Beach Harbor Area. The headwaters of the Dominguez Channel consist of an underground storm drain system which daylights approximately 0.25 miles north of the Hawthorne Municipal Airport. The Dominguez Channel drains approximately 62 percent of the watershed before discharging to Los Angeles Harbor.

The mass emission station, S28, is located near the center of the watershed management area and upstream of the one bioassessment station in the watershed (Figure 6-4).

Figure 6-5 displays how sampling events in 2004-2005 coincided with daily rainfall or extended dry periods. The figure shows that all daily rainfall totals were below 2.5 inches. All wet weather monitoring events occurred during storms having less than 1.5 inches of rain. The wettest period was in late December and early January. The dry event at the mass emission station had an antecedent dry period of 18 days, discounting storm events with less than 0.05 inches of rain.

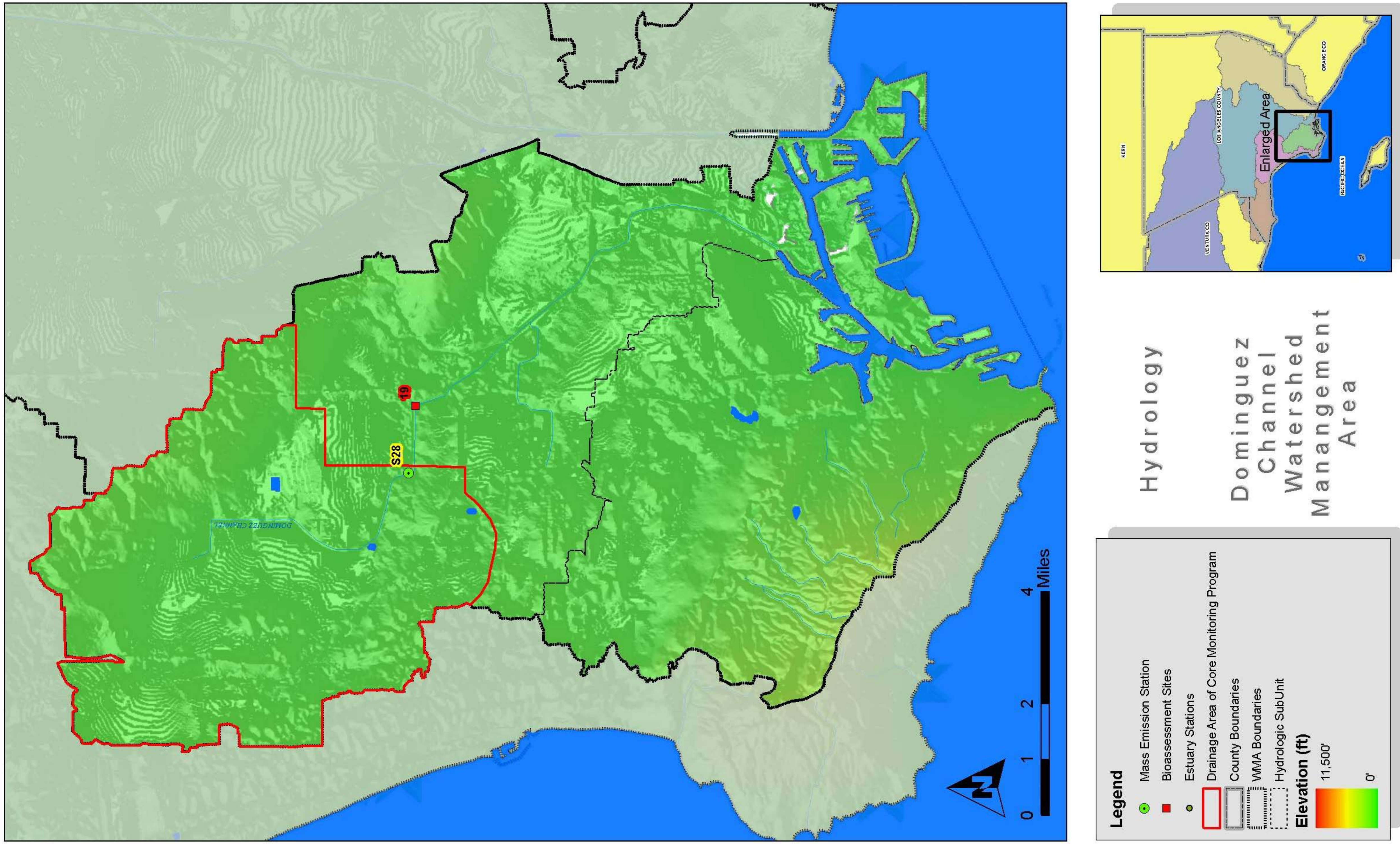

Figure 6-4. Watershed Hydrology and Monitoring Stations in the Dominguez Channel Watershed.

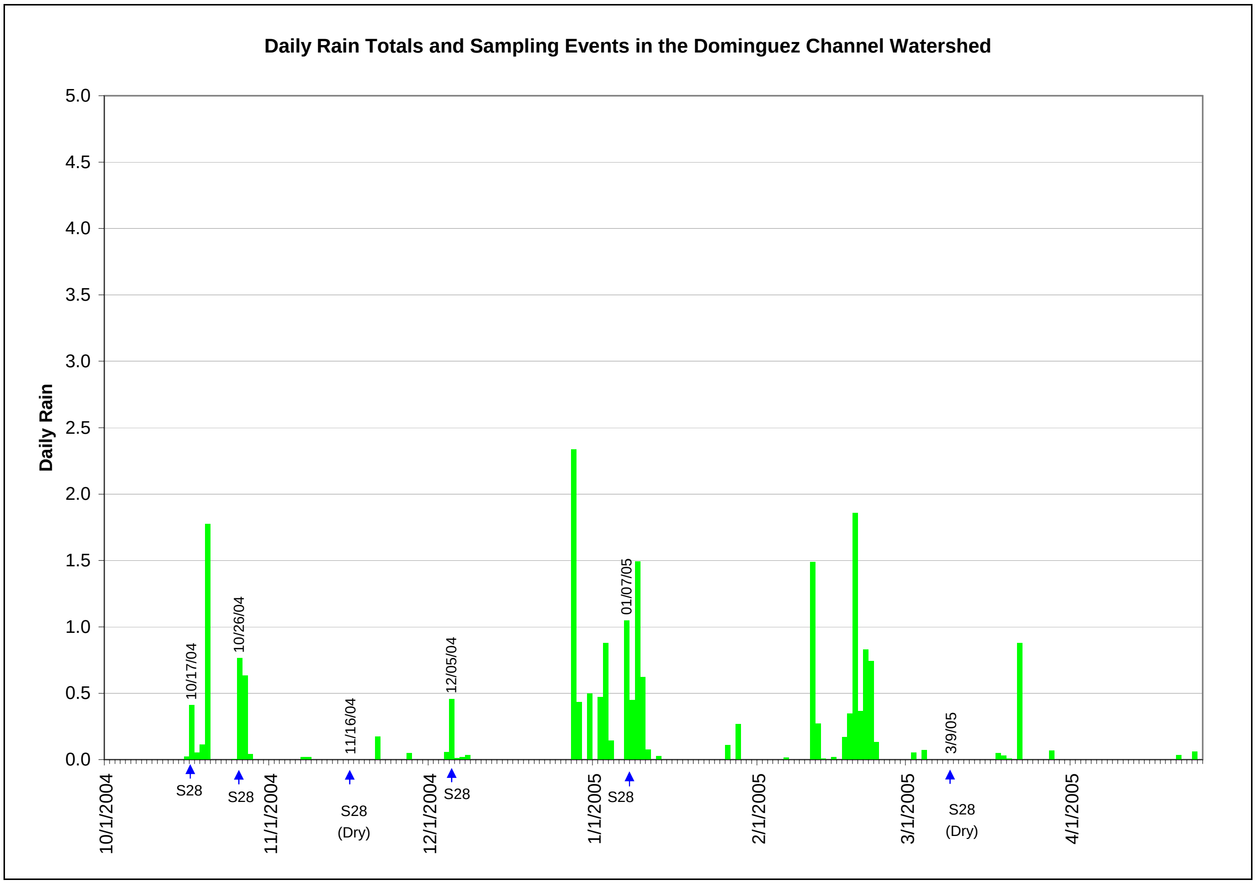

Figure 6-5. Daily Rainfall and Sampling Events during 2004-2005 at Dominguez Channel.

The most intense rainfall occurred in the northern part of the watershed (Figure 6-6). The mass emission station near the center of the watershed would capture most of the resulting flow generated by this rainfall.

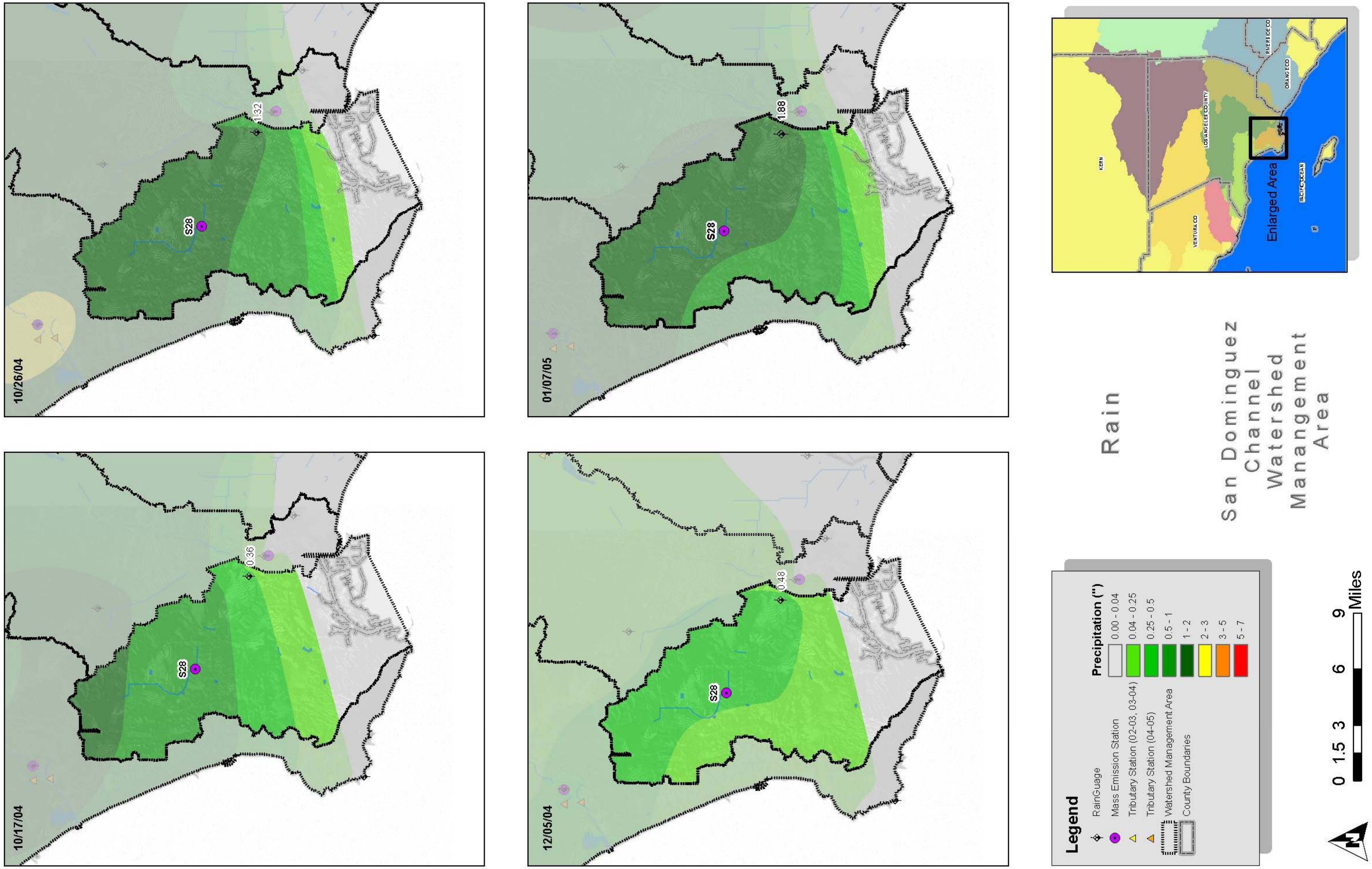

Figure 6-6. Distribution of Rainfall in Dominguez Channel Watershed during Monitored Storm Events in 2004-2005.

6.2 Flow Monitoring

Figure 6-7 shows a historical flow volume record of monitored storms at the Dominguez Channel monitoring station. Monitored flow (green bars) represents the amount of storm flow that is represented in the mass emission station composite sampling. Total flow (blue bars) represents the total amount of storm flow over the entire storm event. Note that the highly variable flow volume appears on a log scale.

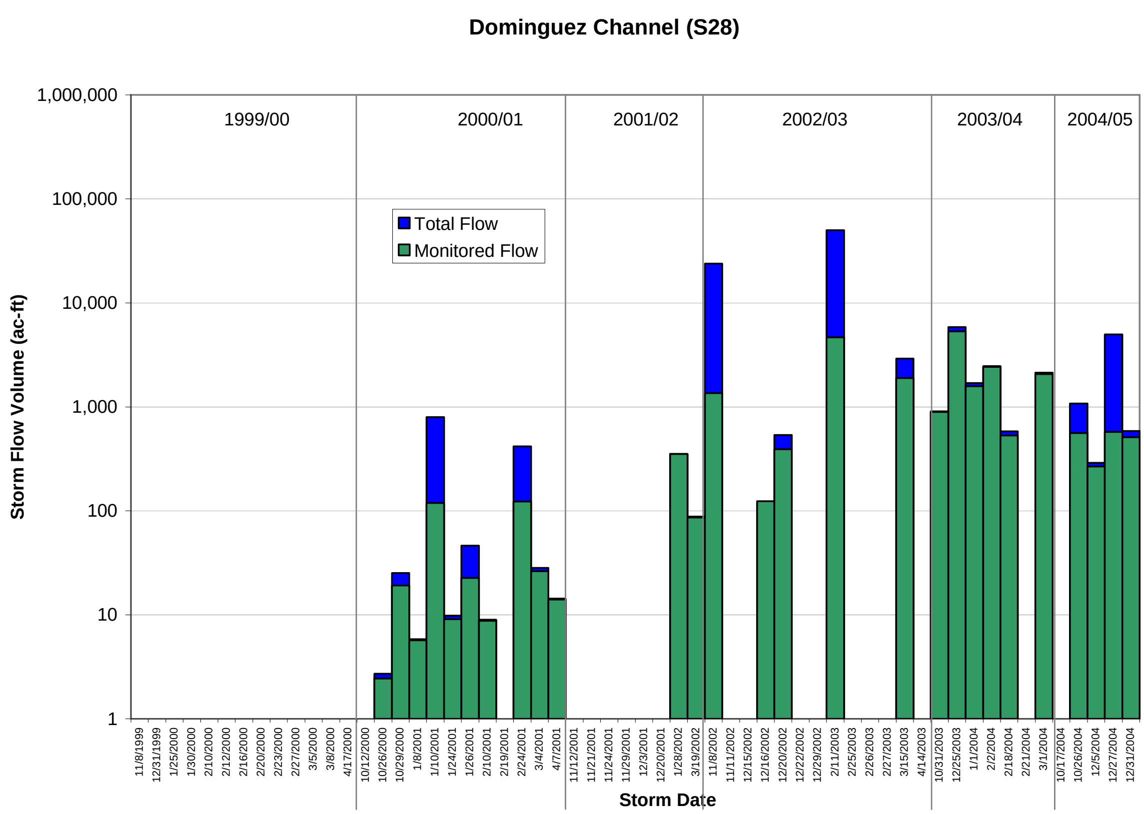

Figure 6-7. Monitored Storm Flow Volumes on the Dominguez Channel.

6.3 Core Stormwater Monitoring Summary

6.3.1 Mass Emissions

Four wet weather events and two dry weather events were monitored at the Dominguez Channel mass emission station during the 2004-2005 monitoring period. Sampling occurred during storms on October 17 and 26, December 5, 2004 and January 7, 2005. The dry weather events were sampled on November 16, 2004 and March 9, 2005. The results from these sampling events are discussed in Section 6.3.1.1 and presented in Appendix C, Table 4. Highlighted cells in Table 4 represent concentrations exceeding respective water quality objectives. This discussion presents the results based on groups of constituents (general chemistry, nutrients, bacterial indicators, metals, semi-volatiles and PCBs, and pesticides and herbicides). Wet weather data for each group of constituents are reviewed and presented first, followed by a brief comparison of the dry weather results. Section 6.3.1.2 presents a summary of the historical data collected at this station and trend analyses performed on the water quality data. Section 6.3.1.3 lists the constituents of concern for this drainage.

6.3.1.1 2004-2005 Results

Three general chemistry constituents exceeded WQOs at least once during the 2004-2005 monitoring season, including cyanide, pH and chloride (Appendix C, Table 4). The pH value was below the Basin Plan criterion of 6.5 during two storm events. Chloride exceeded the Basin Plan criterion during both dry weather events with values of 171 mg/L. Cyanide exceeded the Ocean Plan WQO during one wet weather sampling event. Oil and grease was detected during one wet weather sampling event; however, concentrations were below water quality objectives.

Comparing the four samples collected during storm events, many of the general chemistry constituents had maximum concentrations during the first storm of the season on October 17, 2004. These included all the major ions that comprise TDS, as well as, alkalinity, hardness, COD, BOD, turbidity, TSS and VSS, and MBAS. TDS and the major ions, however, were measured in greater concentrations in the dry weather sample. This is not uncommon because rainfall tends to dilute the levels of these ions during the wet season.

Nutrients were also measured in greatest concentrations during the first storm of the season. This is not surprising, since nutrients are often associated with particulate matter, and TSS levels also peaked during the first storm. Nutrients were detected in all wet and dry weather samples, however none exceeded WQOs.

Indicator bacteria densities exceeded water quality objectives during all four stormwater events. On December 5, 2004, fecal coliform densities were equal to total coliform densities, suggesting a possible sewage source. Although indicator bacteria densities in the dry weather samples were two orders of magnitude lower compared to wet weather samples, fecal coliform and enterococcus densities still exceeded WQOs. Fecal coliforms exceeded objectives during both dry weather events and enterococcus exceeded criteria during one dry weather event. Fecal streptococcus densities were similar to enterococcus densities during all sampling events.

Four metals, including aluminum, copper, lead and zinc exceeded water quality objectives during at least two sampling events. Total aluminum exceeded the WQO during two storm events and total copper, lead and zinc exceeded WQOs during all storm events. Dissolved copper and zinc also exceeded WQOs during all storm events. Dissolved lead exceeded objectives during one storm event. Total copper was the only metal to exceed water quality criteria during both dry weather events.

Dissolved aluminum, total and dissolved beryllium, dissolved cadmium, hexavalent chromium, dissolved manganese, mercury, silver, and thallium were not detected in any wet weather or dry weather samples collected. Total and dissolved selenium were not detected in any stormwater sample, but each was detected in both dry weather samples. Dissolved iron was only detected in the stormwater sample collected on January 7, 2005.

None of the semi-volatile organics, PCBs or herbicides were detected in any of the wet weather samples collected during the 2004-2005 monitoring season. Bis (2-Ethylhexl) phthalate was detected during the last dry weather event with a concentration of 13.60 µg/L. Diazinon was the only pesticide detected and concentrations were above water quality objectives during one storm event. Diazinon was detected in two other storm events and in one dry weather sample; however, concentrations were below the Basin Plan criteria.

6.3.1.2 Historical Review

Table 6-1 presents annual means for the constituents that were monitored from 2001 to 2005 with the appropriate water quality objectives. Each observation was compared to the lowest applicable WQO from the Basin Plan, Ocean Plan, or the California Toxic Rule (CTR) and those above the WQO were highlighted. Water quality objectives for metals are hardness dependent. Metal concentrations were determined using a mean hardness value; however, individual events show specific hardness for that particular event. Therefore, results for individual events may show different results that may be less than water quality objectives. Individual events for each year are presented in the annual reports.

The yellow-highlighted cells in Table 6-1 indicate that a constituent's detection limit is greater than the WQO. For statistical analyses, one-half the detection limit is used in place of a non-detect result. Therefore, annual means generated from values highlighted in yellow may be misrepresentative of actual concentrations. For example, Table 6-1 suggests total mercury and total thallium have consistently exceeded WQOs. However, of all the individual samples collected during the past 4 years, total mercury has only been detected once and thallium has never been detected. In addition, the Ocean Plan applies specifically to discharges to the ocean and not to discharges to enclosed bays, estuaries or inland waters. The Ocean Plan criteria were intended for ocean water samples representative of the discharge area after initial dilution has been completed (SWRCB 2001). Therefore, applying the Ocean Plan criteria to stormwater samples from the Dominguez Channel is intended only to put the data into context and interpreting these results should be done with caution. Concentrations for these constituents were not considered as exceedances.

Table 6-1 also presents frequency and mean magnitude of exceedance ratios for each constituent. The frequency ratio was determined by dividing the total number of years a constituent was analyzed into the number of times the mean value of a constituent exceeded the WQO. The mean magnitude of exceedance was determined by dividing the WQO for a constituent into the constituents mean value for each year, then calculating the average magnitude of exceedance. A frequency ratio greater than 0.5 (50%) and a mean exceedance ratio greater than 1.0 were used as the criteria for determining whether a given parameter should be considered as a COC.

Blue highlighted cells in Table 6-1 represent exceedances of water quality objectives; yellow cells represent constituents in which the detection limits were above water quality objectives and were not considered exceedances; orange cells represent a frequency ratio greater than 0.5 (50% exceedance) and a mean exceedance ratio greater than 1.0.

Table 6-1. Annual Mean Concentration for Constituents Measured at the Dominguez Channel Mass Emission Site, 2001 to 2005.

Constituent	Units	Lowest WQO[1]	2001-02	2002-03	2003-04	2004-05	Frequency Ratio	Mean Exceedance Ratio[2]
General								
Alkalinity	mg/l		36.9	54.7	60.9	58.5	0.0	
Bicarbonate	mg/l		45.0			83.6	0.0	
BOD	mg/l		16.3	17.5	8.5	12.2	0.0	
Calcium	mg/l		13.1			24.7	0.0	
Carbonate	mg/l		1			1	0.0	
Chloride	mg/l	150	20.5	59.8	48.9	45.5	0.0	0.3
COD	mg/l		43.7	55.5	29.1	40.4	0.0	
Cyanide	mg/l	0.004	0.01	0.01	0.01	0.22	1.0	15.0
Dissolved Oxygen	mg/l	<5		9.08	9.83	10.54	0.0	0.5
Fluoride	mg/l	2.2	0.17	0.23	0.23	0.16	0.0	0.1
Hardness	mg/l		49.6	107.2	99.2	92.7	0.0	
Magnesium	mg/l		4.08			7.56	0.0	
MBAS	mg/l		0.15	0.10	0.06	0.12	0.0	
Oil and Grease	mg/l		3.80	2.30	2.18	2.32	0.0	
pH		6.5/8.5	6.78	7.89	7.18	6.77	0.0	
Potassium	mg/l		3.56			4.06	0.0	
Sodium	mg/l		19.9			35.1	0.0	
Specific Conductance	umhos/cm		201	424	356	350	0.0	
Sulfate	mg/l	350	14.7	34.7	35.3	27.4	0.0	0.1
Total Dissolved Solids	mg/l	1500	138.0	272.0	223.6	200.0	0.0	0.1
Total Organic Carbon	mg/l		18.7	12.2	6.2	11.4	0.0	
Total Phenols	mg/l		0.05	0.05	0.05	2	0.0	
Total Suspended Solids	mg/l		70.0	269.2	67.6	109.8	0.0	
Turbidity	ntu	225	44.9	23.6	9.6	19.1	0.0	0.1
Volatile Suspended Solids	mg/l		19.0	42.1	25.8	40.0	0.0	
Nutrients								
Ammonia	mg/l		0.58			0.64	0.0	
Dissolved Phosphorus	mg/l		0.23	0.27	0.16	0.21	0.0	
Kjeldahl-N	mg/l		3.04	1.96	1.33	2.95	0.0	
NH3-N	mg/l		0.48	0.88	0.27	0.52	0.0	
Nitrate	mg/l		2.20	2.94	3.84	4.32	0.0	
Nitrate-N	mg/l	10	0.50	0.70	0.87	0.97	0.0	0.1
Nitrite-N	mg/l	1	0.14	0.12	0.20	0.14	0.0	0.2
Total Phosphorus	mg/l		0.26	0.32	0.18	0.32	0.0	
Indicator Bacteria								
Fecal Coliform	mpn/100ml	400	5,500	128,730	20,060	71,960	1.0	141.4
Enterococcus	mpn/100ml	104	20,500	75,145	182,580	294,160	1.0	1375.9
Fecal Streptococcus	mpn/100ml		23,500	125,283	238,380	294,160	0.0	
Total Coliform	mpn/100ml	10,000	295,000	187,583	35,500	265,800	1.0	19.6
Metals								
Dissolved Aluminum	ug/l		50	50	50	50	0.0	
Dissolved Antimony	ug/l		2.00	2.33	1.66	2.14	0.0	
Dissolved Arsenic	ug/l		1.75	2.15	2.38	1.90	0.0	
Dissolved Barium	ug/l		23.6			30	0.0	
Dissolved Berylium	ug/l		0.5	0.5	0.5	0.5	0.0	
Dissolved Boron	ug/l		121			191	0.0	
Dissolved Cadmium	ug/l	1.3-2.4	0.50	0.53	0.50	0.50	0.0	0.3
Dissolved Chromium	ug/l	36.8-69.2	1.5	2.0	2.9	1.4	0.0	0.0
Dissolved Chromium +6	ug/l		5.0	5.0	5.0	5.0	0.0	
Dissolved Copper	ug/l	4.9-9.5	15.1	12.1	9.6	13.1	1.0	1.7
Dissolved Iron	ug/l		50.0	220.5	71.4	110.0	0.0	
Dissolved Lead	ug/l	1.2-2.7	2.5	1.8	2.2	2.9	0.5	1.2
Dissolved Manganese	ug/l		50.0			50.0	0.0	
Dissolved Mercury	ug/l		0.50	0.50	0.50	0.50	0.0	
Dissolved Nickel	ug/l	28.8-55.2	3.95	5.38	2.77	4.54	0.0	0.1
Dissolved Selenium	ug/l		2.50	2.13	2.06	2.55	0.0	
Dissolved Silver	ug/l		0.5	0.5	0.5	0.5	0.0	
Dissolved Thallium	ug/l		2.5	2.5	2.5	2.5	0.0	
Dissolved Zinc	ug/l	64.7-124.3	109.0	61.1	62.6	89.5	0.3	0.9

Table 6-1. Annual Mean Concentration for Constituents Measured at the Dominguez Channel Mass Emission Site, 2001 to 2005.

Constituent	Units	Lowest WQO[1]	2001-02	2002-03	2003-04	2004-05	Frequency Ratio	Mean Exceedance Ratio[2]
Total Aluminum	ug/l	1000	50.0	301.0	323.0	793.2	0.0	0.4
Total Antimony	ug/l	6	2.7	2.5	1.9	2.6	0.0	0.4
Total Arsenic	ug/l	32	1.75	2.55	2.39	2.04	0.0	0.1
Total Barium	ug/l		36			55.7	0.0	
Total Beryllium	ug/l	4	0.5	0.5	0.5	0.5	0.0	0.1
Total Boron	ug/l		144			460	0.0	
Total Cadmium	ug/l	1.4-2.6	0.5	0.6	0.5	0.5	0.0	0.2
Total Chromium	ug/l	50	2.8	8.0	6.5	4.7	0.0	0.1
Total Chromium +6	ug/l			5.0	5.0	5.0	0.0	
Total Copper	ug/l	5.1-9.9	38.1	22.6	19.9	38.8	1.0	4.1
Total Iron	ug/l		188	542	528	1196	0.0	
Total Lead	ug/l	1.3-3.5	2.5	5.2	4.6	11.0	1.0	2.2
Total Manganese	ug/l		50.0			61.6	0.0	
Total Mercury	ug/l	0.16	0.5	0.5	0.4	0.5	1.0	3.0
Total Nickel	ug/l	28.8-55.3	5.1	11.0	4.8	7.6	0.0	0.2
Total Selenium	ug/l	60	2.5	2.3	2.1	2.5	0.0	0.0
Total Silver	ug/l	2.8	0.5	0.5	0.5	0.5	0.0	0.2
Total Thallium	ug/l	2	2.5	2.5	2.5	2.5	1.0	1.3
Total Zinc	ug/l	66-127	109	102	94	171	0.5	1.2
Pesticides								
Diazinon	ug/l	0.08	0.28	0.08	0.03	0.06	0.5	1.4
Prometryn	ug/l			1	1	1	0.0	

[1] WQO for metals are hardness dependent and were based on minimum hardness by year.
[2]Mean Exceedance Ratio calculated using annual mean concentrations reported up to four significant figures. Ratio shown may not exactly equal ratio of mean values shown in table due to rounding of presented means.
Blue = WQO Exceedances; Yellow = DL above WQO; Orange = Frequency ratio > 0.5, Mean exceedance > 1.0.

Annual mean concentrations of each constituent for 2004-2005 are similar to annual mean concentrations measured in previous years (Table 6-1). The Dominquez Channel mass emission site was established for the 2001-2002 monitoring season, therefore the historical data record only contains 3 years of data previous to the 2004-2005 monitoring season. Annual means of cyanide, indicator bacteria, total and dissolved copper, and total lead have exceeded WQOs during all four years. Total zinc and dissolved lead have exceeded water quality objectives during two years. The annual mean concentration of dissolved zinc has exceeded the water quality objective only during the 2001-2002 monitoring season. The annual mean concentration of diazinon has been above the WQO during two monitoring years.

Regression analyses were performed on the annual mean concentrations of all the stormwater constituents monitored since 2001-2002 to determine if any of the constituents had a significantly increasing or decreasing trend. In the Dominguez Channel, only one constituent was found to have a significantly increasing trend in annual means. Total lead has increased from 2.5 mg/L in 2001-2002 to an annual mean of 11.0 mg/L in 2004-2005 during the wet season (Figure 6-8).

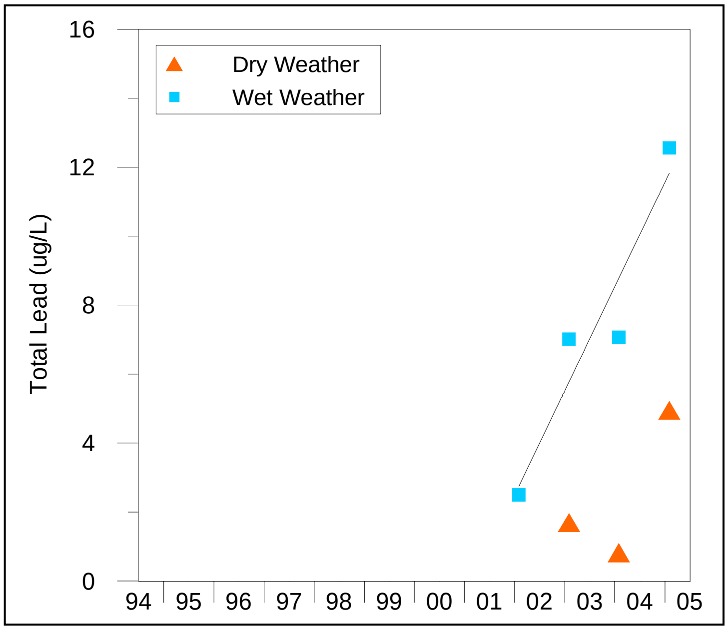

Figure 6-8. Scatterplot and Trend for Total Lead at the Dominguez Channel Mass Emission Site, 2001 to 2005.

6.3.1.3 Constituents of Concern

The constituents of concern for Dominguez Channel are shown in Figure 6-9 and Table 6-2. A constituent is considered a COC if its frequency ratio exceeds 0.5 and/or mean exceedance ratio exceeds 1.0 (see Section 6.3.1.2 for an explanation of how frequency ratios and mean exceedance ratios are derived). Therefore, COC's as they are designated in this report serve as flags for water quality managers and should not be used for other purposes such as regulatory compliance.

At the mass emission site in Dominquez Channel, the constituents of concern included cyanide, indicator bacteria, copper, lead, zinc and diazinon. Enterococcus densities had the highest exceedance ratio (1375.9). The mean exceedance ratios for fecal and total coliform were 141.4 and 19.6, respectively. Total copper and lead consistently have been measured at concentrations over 10 times their WQOs. Total zinc had a mean exceedance ratio of 1.2. Dissolved copper and lead had mean exceedance ratios of 1.7 and 1.2, respectively. Based on the 2004-2005 monitoring data, only dissolved zinc of the COCs identified indicated a "first flush" phenomena in that the highest concentrations were observed in the first storm event sample.

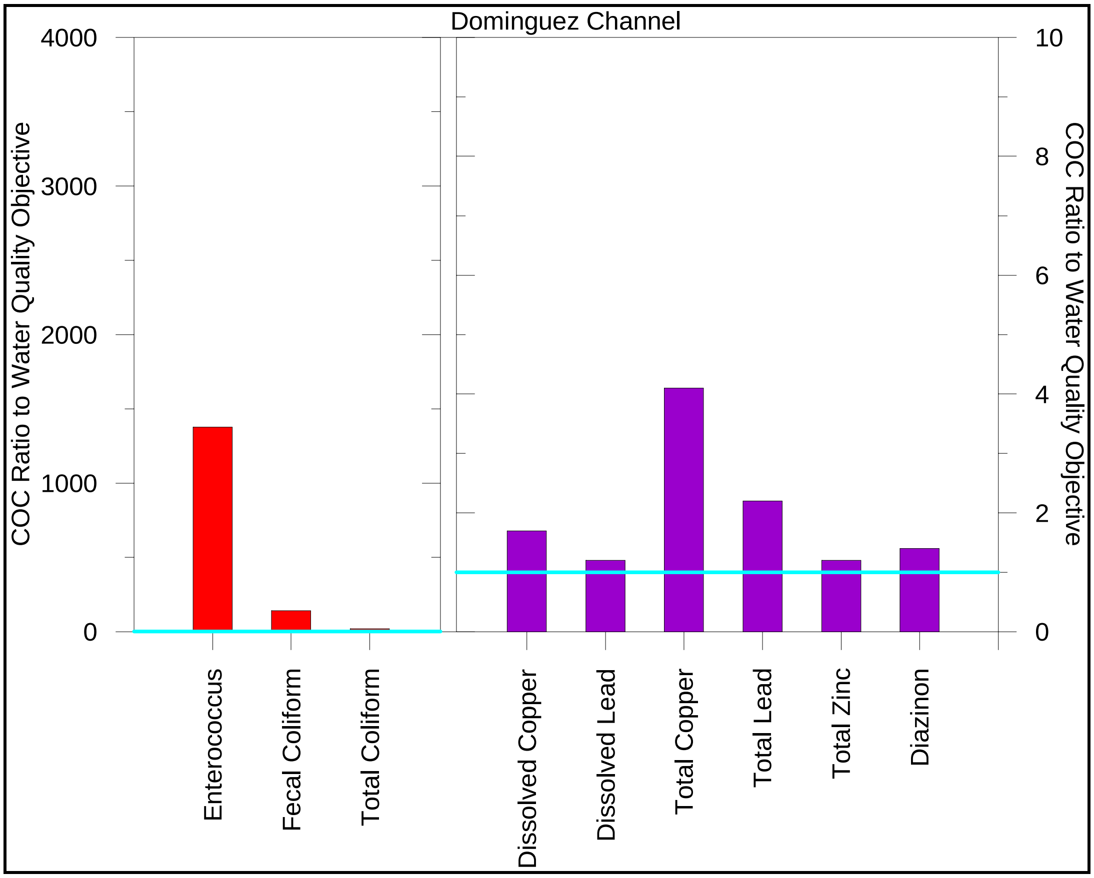

Figure 6-9. Mean Exceedance Ratio for Constituents Frequently Exceeding WQOs at the Dominguez Channel Mass Emission Site.

Cyanide had a mean exceedance ratio of 15.0 and was identified as a COC; however, it is not included in Figure 6-9 as the graph focuses on indicator bacteria, metals and diazinon. The origin of cyanide detected in the stormwater samples can be from a number of potential anthropogenic and natural non-point sources. It is assumed that potential industrial point sources are regulated under their own individual NPDES permit. Stormwater runoff from metal plating and finishing operations can be source of cyanide. Non-point sources of cyanide may include pesticide use. The largest likely source of cyanide in the WMA is air-borne deposition from motor vehicle emissions. The amount of cyanide that could be released to the environment from natural sources is comparatively low. Potential natural sources of cyanide include incomplete combustion from forest fires, decomposition of plant material and fungi. Water concentrations of cyanide tend to breakdown within days, but may bind to organic matter in sediments carried by stormwater and remain more persistent (www.eco-usa.net, www.dsf.health.state.pa, www.cynaidecode.org, www.npi.gov).

Total mercury and total thallium have exceeded water quality objectives since 2001-2002 (Table 6-1). However, it should be noted that the detection limits for these constituents are greater than the water quality objectives. Therefore, these constituents were not identified as COC's because exceedances could not be determined.

Table 6-2 summarizes the constituents of concern identified by the mass emission data and compares them to the pollutants on the 303(d) list for Dominguez Channel. Constituents indicating increasing trends are also shown in Table 6-2. The first column of Table 6-2 lists constituents of concern as determined from the integrated data set of annual mean values; the second column lists constituents that show an increasing trend (Figure 6-8) even though concentrations may be below water quality objectives; and the third column is presented for comparison purposes and provides constituents that are 303(d) listed.

Dominguez Channel has been 303(d) listed for numerous nutrients, metals and organics, which have impaired its water quality, sediment quality and biological community. Water quality is listed for high levels of ammonia, copper and elevated coliform densities. Sediment quality is impaired due to chromium, zinc, DDT and PAHs. Tissue samples have been degraded because of aldrin, chlordane, DDT, dieldrin, PCBs and lead.

Table 6-2. Constituents of Concern, Increasing Trends and Comparison to 303(d) List in Dominguez Channel.

Constituent	Constituents of Concern Based on Mass Emission Data Frequency/Magnitude	Constituents Indicating Increasing Trend	Comparison to 303 (d) List
Cyanide	X		
Enterococcus	X		
Fecal Coliform	X		X
Total Coliform	X		X
Ammonia			X
Total Copper	X		X
Total Lead	X	X	X
Total Zinc	X		X
Dissolved Copper	X		X
Dissolved Lead	X		X
Dissolved Zinc			X
Diazinon	X		
Chromium			X
DDT			X
PAH's			X
Aldrin			X
Chlordane			X
Dieldrin			X
PCB's			X

The water quality samples collected at Dominguez Channel substantiate several of these listings. Monitoring has recorded concentrations above the WQO for cyanide, indicator bacteria, copper, lead, zinc and diazinon. Metals tend to bind to suspended solids which will settle on the channel bottom when the storm flows recede following a storm. Therefore, the elevated levels of these metals in the water column are likely contributing to the higher sediment concentrations and may be more available to organisms that live and feed within the sediment. However, cyanide and diazinon have been identified as COCs but are not included on the 303(d) list. Alternatively, ammonia, chromium, aldrin, chlordane, dieldrin, PCBs, PAHs, and DDT are included on the

303(d) list, however concentrations of these constituents in the Dominguez Channel have either not been detected or have been consistently below WQOs.

6.3.2 Water Column Toxicity Monitoring

Samples collected from the Dominguez Channel mass emission site were analyzed for toxicity to *Ceriodaphnia dubia* survival and reproduction and sea urchin fertilization. Samples from each monitoring period since 2002-2003 were used in the bioassays. Composited wet (or storm) and dry weather event samples were tested for toxicity.

Water column toxicity monitoring found that stormwater sampled from the Dominguez Channel mass emission station on October 17 and 26, 2004 inhibited the survival of *C. dubia* and the reproductive success of sea urchins. Reproductive success of *C. dubia* was not affected during either of these dates. Dry weather samples collected during 2004-2005 affected *C. dubia* reproduction and sea urchin fertilization.

Toxicity monitoring conducted prior to the 2004-2005 season determined that stormwater from the Dominguez Channel collected during 2002-2003 affected *C. dubia* survival and reproduction. Stormwater and dry weather samples collected during 2003-2004 only inhibited sea urchin fertilization.

In 2002-2003, TIEs identified the toxic pollutant in stormwater as one or more non-polar organic compounds, cationic metals, and metabolically-activated organophosphates. In 2003-2004 the toxic pollutant in stormwater was believed to be a volatile compound.

Further discussion of toxicity results and inter-relationships on a cross-watershed basis is presented in Section 10. Due to the limited data-set on a watershed basis, the inter-relationship discussion is presented on regional basis in Section 10. Correlations between toxicity results with COC are discussed in section 10 using the results from all the watersheds.

6.3.3 Trash Monitoring

Photos were taken at the Dominguez Channel mass emission station after four storms, including the first storm event of the season for each year. Photos from the 2004-2005 storm season are provided in Appendix D, Figures 13-16.

6.4 Regional Monitoring Summary

6.4.1 Bioassessment Results/Discussion

Information on the stream bioassessment surveys of October 2003 and October 2004 originally appeared in annual monitoring reports submitted to LACDPW (BonTerra 2004, Weston 2005). In the discussion below, ratings of the benthic macroinvertebrate communities is based on a CFG Southern California Index of Biotic Integrity (IBI) (Ode et al. 2005 (In Press)), a quantitative scoring system based on the cumulative value of seven biological metrics. The scoring range is 0-70, and the scores are categorized into qualitative ratings of Very Poor (0-13), Poor (14-26), Fair (27-40), Good (41-55), and Very Good (56-70). Additional individual metrics and aspects of species composition are discussed when notable. Section 10 of this report provides more overview and detail of the results from the regional monitoring.

6.4.1.1 Introduction

Stream bioassessment monitoring was conducted at one site in the Dominguez Channel Watershed. The location of the site is presented in Figure 6-4, and a description of the site and the justification for the monitoring location is presented in Table 6-3. The site was located in the main stem of Dominguez Channel at the Vermont Avenue over crossing, in a fully concrete-lined channel. Field biologists noted the presence of a thick blue-green algae film on the substrate with an organic odor.

Table 6-3. Dominguez Channel stream bioassessment monitoring site. October 2003 and 2004.

Station	Receiving Water Body	Location	Coordinates	Justification
19	Dominguez Channel Lined channel	Dominguez Channel and Vermont Ave	N 33º 52.257’ W 118º 17.418’	Original location relocated due to tidal influence

6.4.1.2 Benthic Macroinvertebrate Community

The benthic macroinvertebrate community at Dominguez Channel was rated Very Poor, with total CFG’s Southern California Index of Biotic Integrity scores of 3 (2003) and 6 (2004) (Table 6-4). Chironomid midges and Oligochaetes were the dominant organisms in both years. The highly tolerant snail *Physa* was present in high numbers in 2003, but not in 2004. The majority of taxa at the site consisted of Dipteran taxa (true flies), including *Psychoda*, which is highly tolerant of organic pollution (Usinger 1956). Values for pH were above 9.0 in both surveys, while specific conductance was relatively low, with readings of 0.670 ms/cm and 0.683 ms/cm.

Table 6-4. Index of Biotic Integrity and Water Quality Measures of the Dominguez Channel Watershed.

Dominguez Channel Watershed	Station 19 Dominguez Channel (lined channel)	
Survey	**Oct-03**	**Oct-04**
Index of Biotic Integrity/ Qualitative Rating	3 Very Poor	6 Very Poor
Water Quality		
Temperature (C)	23.8	27.5
pH	9.2	9.0
Specific Conductance (ms/cm)	0.670	0.683
Hardness (mg/L $CaCO_3$)	NS	336
Dissolved Oxygen (mg/l)	14.65	14.02

6.4.1.3 Relationship of Bioassessment to Constituents of Concern

Data from the mass emissions stations, summarized in Section 6.3, were used to identify possible relationships between COCs and impacts to the benthic macroinvertebrate communities. Additional impairments identified in the 303 (d) listing were not considered here due to a lack of available recent data.

Bioassessment Station 19-Dominguez Channel was located in close proximity to the Dominguez Channel mass emissions station S28 (Figure 6-4). The benthic community was rated Very Poor, and the physical habitat in this stream reach was also poor. Identified COCs included total and dissolved metals including copper, lead and zinc (Table 6-2). High concentrations of heavy metals have long been known to negatively impact macroinvertebrate communities (e.g., Winner et al. 1980). Cyanide and diazinon exceeded WQOs by small margins, although diazinon showed a decreasing trend since 2001. Bacteria levels were consistently very high, and while bacteria likely did not directly impact the benthic community, they generally indicate other water quality issues such as elevated fine organic matter or nutrients that could degrade the system.

6.4.2 Estuary Sampling Program Results/Discussion

Six stations within the Dominguez Channel Estuary, identified as 4206, 4270, 4436, 4852, 5012 and 5108, were monitored under the supervision of SCCWRP in the summer of 2003. The locations of the stations are presented in Figure 6-10. Samples were analyzed for sediment chemistry, sediment toxicity and benthic macroinvertebrate diversity. The results from these sampling events are discussed in the following section and presented in Table 6-5. The complete list of laboratory analytical data results are presented in Appendix E, Table 3.

Currently, there are no universally accepted criteria for assessing contaminated sediments. However, SCCWRP decided to utilize Effect Range-Low (ER-L) and Effect Range-Median (ER-M) values to evaluate the potential for sediment to cause adverse biological effects (Long et al. 1995). The guidelines were intended to provide informal (non-regulatory) effects-based benchmarks of sediment chemistry data (Long et al. 1998). Two effects categories have been identified:

ER-L – Effects Range-Low: concentrations below which adverse biological effects are rarely observed; and

ER-M – Effects Range-Median: concentrations above which adverse biological effects are more frequently, though not always observed.

Sediment chemistry data from samples collected from each of the estuaries were compared to the ER-L and or the ER-M data (Table 6-5).

In addition, for each estuary ER-M values were used to calculate a mean ER-M quotient (ERM-Q). The concentration of each constituent was divided by its ER-M to produce a quotient, or proportion of the ER-M equivalent to the magnitude by which the ER-M value is exceeded or not exceeded. The mean ERM-Q for each embayment was then calculated by summing the ERM-Qs for each constituent and then dividing by the total number of ERM-Qs assessed. ERM-Qs were not calculated for constituents below the detection limit and thus were not used in the generation of the mean ERM-Q. The mean ERM-Q thus represents an assessment for each embayment of the cumulative sediment chemistry relative to the threshold values. In this way, the cumulative risks of effect to the benthic community can provide a mechanism to compare embayments. This method has been used and evaluated by several researchers (Hyland et al. 1999, Carr et al. 1996, Chapman 1996, and Long et al. 1995) throughout the country.

The aggregate approach using an ERM-Q is a more reliable predictor of potential toxicity but should not be used to infer causality of specific contaminants. ER-L and ER-M values were originally derived to be broadly applicable and they cannot account for site-specific features that may affect their applicability on a more local or regional level. Local differences in geomorphology can result in chemicals being more or less available and therefore more or less toxic than an ER-L or ER-M value might indicate. Additionally, some regions of the country are naturally enriched in certain metals and local organisms have become adapted.

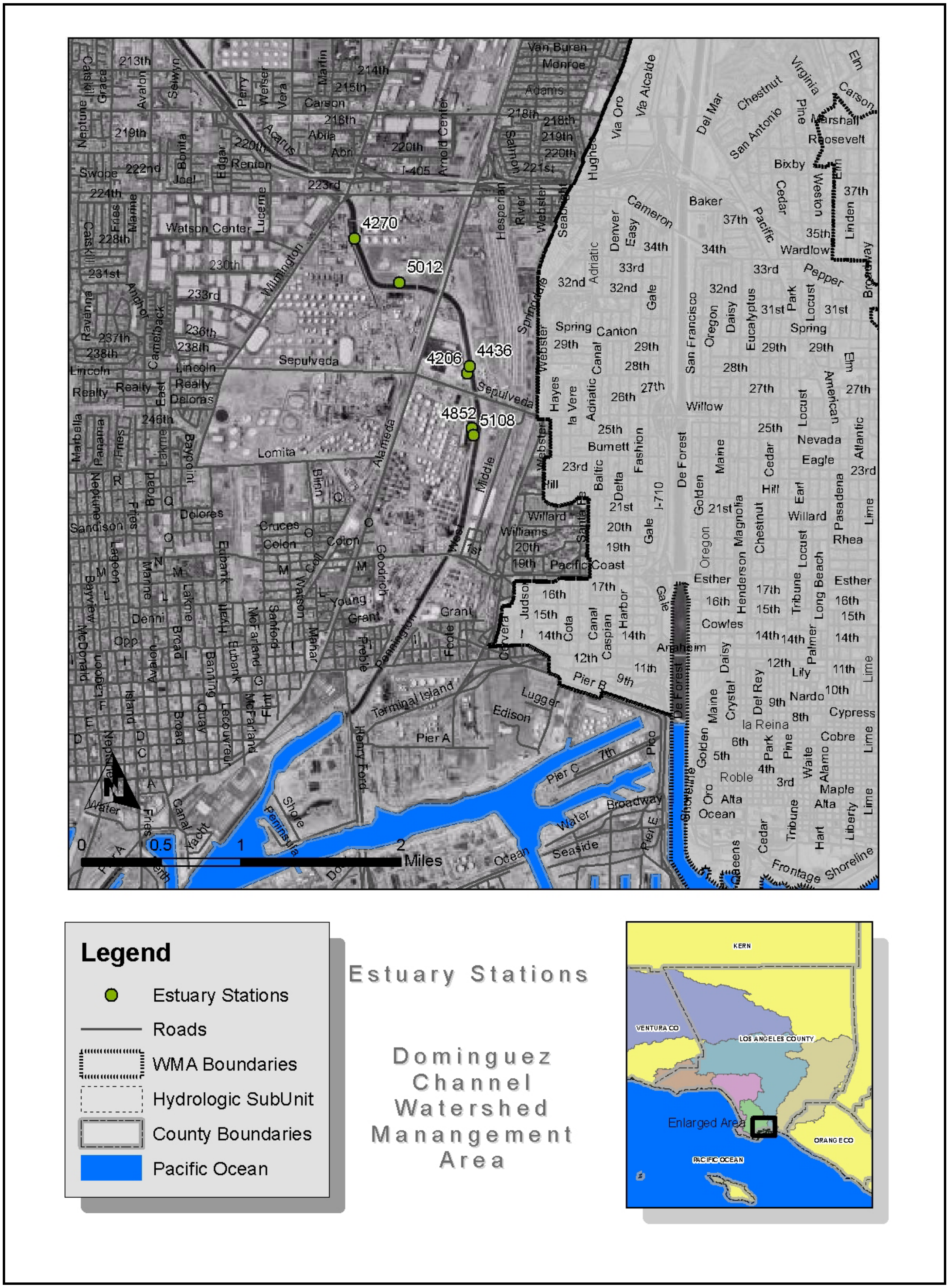

Figure 6-10. Dominguez Channel Estuary Sampling Stations.

Table 6-5. Analytical Results for Constituents Analyzed in the Dominguez Channel Estuary.

Constituent	Units	ER-L*	ER-M*	Dominguez Channel Estuary					
				4206	4270	4436	4852	5012	5108
Toxicity									
Mean Eohaustorius Survival	%			**32**	**20**	**25**	88	92	95
Infauna Community Indices									
Number of species	#/0.1 m^2			22	8	20	24	13	24
Total abundance	#/0.1 m^2			862	65	1099	1308	622	2026
Shannon-Wiener diversity				1.36	1.57	1.40	1.07	1.23	1.61
Evenness				0.44	0.76	0.47	0.34	0.48	0.51
Dominance				2	3	3	1	2	3
Sediment Size and TOC									
Gravel	%			0.00	0.00	0.00	1.95	0.00	0.00
Sand	%			16.33	15.40	29.30	80.00	41.40	32.31
Silt	%			73.96	75.61	57.21	14.43	53.17	60.72
Clay	%			9.70	8.99	13.50	3.46	5.43	6.96
Median size	microns			18.81	19.08	24.65	575.55	38.24	26.26
Mean size	microns			19.14	19.19	23.73	218.35	41.57	40.70
TOC	%			5.776	2.989	4.224	1.494	3.418	1.663
Metals	mg/kg								
Arsenic	mg/kg	8.2	70	**12.20**	**15.40**	**17.20**	3.17	7.45	**12.20**
Cadmium	mg/kg	1.2	9.6	**4.70**	**3.09**	**4.71**	0.31	**4.32**	1.03
Chromium	mg/kg	81	370	**200.0**	**296.0**	**269.0**	26.3	63.6	**291.0**
Copper	mg/kg	34	270	**175.0**	**248.0**	**171.0**	26.4	**117.0**	**205.0**
Lead	mg/kg	46.7	220	**493.0**	**288.0**	**720.0**	37.9	139.0	**94.3**
Mercury	mg/kg	0.15	0.71	**0.59**	**0.40**	**0.48**	0.06	**0.24**	**0.47**
Nickel	mg/kg	20.9	51.6	**49.9**	**43.5**	**57.1**	9.4	**30.6**	**31.0**
Silver	mg/kg	1	3.7	**4.33**	**3.63**	**4.43**	0.14	0.56	**1.06**
Zinc	mg/kg	150	410	**789.0**	**666.0**	**822.0**	86.9	**461.0**	**254.0**
Pesticides									
Total detectable DDT	µg/kg	1.58	46.l	**913.2**	**407.3**	**1146.9**	**18.5**	**57.0**	**9.3**
Total detectable chlordane	µg/kg	0.6	6	**96.2**	**53.4**	**152.5**	0	0	0
PAHs									
Total detectable PAHs	µg/kg	4022	44,800	**8363**	**7000**	**6988**	3108	**6149**	**10333**
PCBs									
Total detectable PCBs	µg/kg	22.7	180	**314.8**	**322.5**	**378.3**	0.0	**53.3**	7.3
Mean ER-M quotient				**3.60**	**2.10**	**4.84**	**0.11**	**0.44**	**0.38**

* Effects Range-Low and Effects Range-Median (Long et al. 1995)
Chemistry results in **bold** = exceeds ER-L
Chemistry results in **bold** = exceeds ER-M
Toxicity in **bold** = identified as moderately toxic (Bight 03 draft report, SCCWRP 2004)
Toxicity in **bold** = identified as highly toxic (Bight 03 draft report, SCCWRP 2004)
Mean ERM-Q in **bold** = above 0.10 threshold (Long et al. 1998)
NR = not reported
J = Estimated value above MDL and below RL

Sediment Chemistry. Sediments were analyzed for four groups of constituents: metals, pesticides, PAHs, and PCBs. Nine metals, including arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc exceeded either the ER-L or ER-M at the majority of the stations within the Dominguez Channel Estuary. Arsenic and cadmium exceeded the ER-L at four of the six stations with values ranging from 12.20 to 17.20 mg/kg and from 3.09 to 4.71 mg/kg, respectively. Concentrations of chromium exceeded the ER-L at four stations. Values ranged from 200 to 296 mg/kg. Copper and mercury exceeded the ER-L at five out of six stations, with values ranging from 117 to 248 mg/kg and from 0.24 to 0.59 mg/kg, respectively. Lead exceeded the ER-L at one station with a value of 94.3 mg/kg and exceeded the ER-M at three stations with concentrations ranging from 288 to 720 mg/kg. Nickel exceeded the ER-L at four stations with values ranging from 30.6 to 49.9 mg/kg and exceeded the ER-M at one station with a value of 57.1 mg/kg. Silver concentrations exceeded the ER-L at two stations and exceeded the ER-M at two stations with values of 4.33 and 4.43 mg/kg. Zinc concentrations exceeded the ER-L at one station with a value of 254 mg/kg and exceeded the ER-M at four stations with values ranging from 461 to 822 mg/kg. Copper, lead, and zinc exceedances have been consistently observed at the mass emission station, suggesting a possible connection between COC's at the mass emission station and within the estuary. There were detections of other metals, including aluminum, antimony, barium, beryllium, iron, and selenium at all stations; however, ER-L and ER-M values were not available so comparisons could not be made.

The only pesticides with concentrations above ER-L and ER-M values were total detectable DDT and total detectable chlordane. Total detectable chlordane exceeded the ER-M at three of the six stations, including 4206, 4270, and 4436. Values ranged from 53.4 at station 4270 to 152.5 µg/kg at station 4436. Total detectable chlordane was not detected at the other three stations. Total detectable DDT exceeded the ER-L or ER-M at all six stations. The ER-L was exceeded at two stations, with values of 9.3 and 18.5 µg/kg. Total detectable DDT exceeded the ER-M at four stations with concentrations ranging from 57 to 1146.9 µg/kg.

Total detectable PAHs exceeded the ER-L at five out of the six stations with concentrations ranging from 6,149 to 10,333 µg/kg. Total detectable PCBs exceeded the ER-L at one station and exceeded the ER-M at three of the six stations, including 4206, 4270, and 4436.

ERM-Q values were all above the threshold of 0.10 for all six stations monitored in the Dominguez Channel Estuary. Station 4436 had the highest mean ERM-Q with a value of 4.84. Stations 4206 and 4270 had mean ERM-Q values of 3.60 and 2.10, respectively. Stations 4852, 5012, and 5108 had lower mean ER-M quotients; however, they were still above the 0.10 threshold. ERM-Q values at these stations ranged from 0.11 to 0.44.

Similar patterns of exceedances were observed among stations in the Dominguez Channel Estuary. Stations 4206, 4270 and 4436 each had thirteen ER-L or ER-M exceedances of metals, total detectable DDT, total detectable chlordane, total detectable PAHs and total detectable PCBs. These stations also had the lowest percent survival of *E. estuarius* (see below) and the highest mean ERM-Q values. Station 4270 was the uppermost station sampled in the estuary and stations 4206 and 4436 were located very closely to each other in the middle section of Dominguez Channel Estuary. Station 5108, located in the bottom portion of the estuary, had ten total exceedances, including metals, total detectable DDT and total detectable PAHs. Station 5012 had eight total exceedances, including metals, total detectable DDT, total detectable PAHs and total detectable PCBs. Station 4852, which was located next to station 5108, only had one exceedance (total detectable DDT) and it had the lowest ERM-Q value.

Sediment Toxicity. The mean percent survival of the test organism, *E. estuarius,* exposed to Dominguez Channel sediments ranged from 20 to 95%. Percent survival was the lowest at stations 4270, 4436, and 4206 with values of 20%, 25%, and 32%, respectively. These values suggest that the Dominguez Channel Estuary sediments in these areas are highly toxic to the test organisms (Bight 03 draft report, SCCWRP 2004). The mean percent survival of *E. estuarius* at stations 4852, 5012, and 5108 ranged from 88 to 95%, suggesting that the sediments in these areas were not toxic to the test organisms.

Benthic Community Structure. Station 5108 had the greatest number of animals with $2026/0.1m^2$ followed by station 4852 which had $1308/0.1m^2$. These two stations also had the most number of species with $24/0.1m^2$. Species diversity was highest at station 5108. Taxa abundance and richness were lowest at station 4270 but evenness was highest at this station. Dominance was highest at stations 4270, 4436, and 5108 and lowest at station 4852.

Sediment Size. At all but one of the six stations sampled in the Dominguez Channel Estuary, silt was the dominant sediment constituent, followed by sand. The one site that did not fit this pattern was station 4852, which had a much larger median grain size (575.55 microns). Sediments at this station had a much larger proportion of sand (80%) and it was the only station that had gravel (1.95%). It also had the lowest TOC content (1.5%).

6.5 Conclusions

Cyanide, indicator bacteria, copper, lead, zinc and diazinon are constituents of concern in the Dominguez Channel based on water quality data collected at the mass emission site since 2001-2002. These constituents have persistently exceeded WQOs. Total lead was the only constituent identified with significantly increasing concentrations in the water column.

The Dominguez Channel has been CWA 303(d) listed for several constituents including indicator bacteria, copper, lead, zinc, and ammonia. Water quality data collected from the mass emission site in Dominguez Channel supports the listing of bacteria, copper, lead, and zinc as they were identified as constituents of concern. However, water quality monitoring of ammonia has shown that concentrations have never exceeded water quality objectives.

Water column toxicity, potentially caused by one or more non-polar organic compounds, cationic metals, metabolically-activated organophosphates or a volatile compound in Dominguez Channel stormwater, affected the survival and/or reproductive success of *C. dubia* and sea urchins.

Stream bioassessment monitoring surveys were conducted in October 2003 and October 2004. Bioassessment monitoring sites were located at one monitoring reach in the Dominguez Channel to assess biological integrity and to detect biological trends and responses to pollution in receiving waters throughout the region. The benthic macroinvertebrate community in Dominguez Channel had Index of Biotic Integrity scores of three and six, and a quality rating of Very Poor.

The Dominguez Channel Estuary was monitored to estimate the extent and magnitude of ecological change in the Southern California Bight (SCB) and to determine the mass balance of pollutants that currently reside within the SCB. Sediments from six stations within the estuary were analyzed for chemistry, toxicity and benthic macroinvertebrate diversity. The results of the chemistry assessment indicated that nine metals exceeded either the ER-L or ER-M at the majority of the stations. Total detectable chlordane, total detectable DDT, total detectable PAHs, and total detectable PCBs all exceeded either ER-L or ER-M values at the majority of the stations. ERM-Q values were all above the threshold of 0.10 for all six stations monitored in the Dominguez Channel Estuary. Sediment toxicity was determined to be highly toxic to the test organisms at three of the stations.